AD-A184 522   ELECTRONIC SYSTEM RELIABILITY AND EFFECTIVENESS(U)   1/1
CALIFORNIA UNIV BERKELEY ENGINEERING RESEARCH CENTER
R E BARLOW 03 AUG 87 N00014-85-K-0384
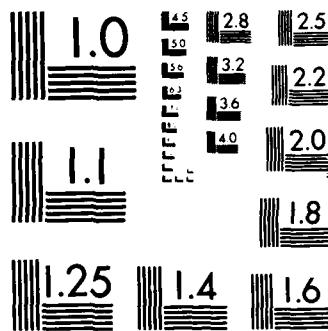
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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Final Report - Electronic System Reliability & Effectiveness		5. TYPE OF REPORT & PERIOD COVERED FINAL 4-10-85 to 4-9-87
		6. PERFORMING ORG. REPORT NUMBER —
7. AUTHOR(s) Richard E. Barlow		8. CONTRACT OR GRANT NUMBER(s) N00014-85-K-0384
9. PERFORMING ORGANIZATION NAME AND ADDRESS Engineering Systems Research Ctr. (ORC) 3115 Etcheverry Hall, U.C. Berkeley Berkeley, CA 94720		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Office of Naval Research 800 N. Quincy St. Arlington, VA 22217-5000		12. REPORT DATE 8-3-87
		13. NUMBER OF PAGES 4
14. MONITORING AGENCY NAME & ADDRESS(If different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Unlimited

DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

Unlimited

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

August 3, 1987

FINAL REPORT

ELECTRONIC SYSTEM RELIABILITY AND EFFECTIVENESS

CONTRACT: N00014-85-K-0384

April 10, 1985--April 9, 1987

Principal Investigator: Richard E. Barlow

U. C. Berkeley

Reports:

Barlow, R. E. and S. Iyer. Computational Complexity of Coherent Systems
and the Reliability Polynomial. Operations Research Center
Technical Report ORC 85-6, July 1985. Tentatively accepted for
publication in Mathematics of Operations Research. Under revision.

Resende, L. "Extensions to Polychain: Nonseparability Testing and
Factoring Algorithm", ORC 85-14, 1985. Operations Research Center,
University of California, Berkeley, CA (Also a project with the
same title but with extensive applications to the ARPA network.)

Resende, L. "An Implementation of the Factoring Algorithm for
Reliability Evaluation of Undirected Networks." Submitted to IEEE
Transactions on Reliability. (Publication revision of previous
report.)

87 8 26 094

L. Resende. "A Preprocessing for Monte Carlo Algorithms for the
K-Terminal Network Reliability Problem." Unpublished preprint
relative to Ph.D. thesis research work.

Shachter, R. D. and L. J. Bertrand. "Efficient Inference on Generalized
Fault Diagrams." Paper Delivered at the <u>Third Workshop on Uncertainty
in Artificial Intelligence,</u> Seattle, Washington, July 10-12, 1987.

Barlow, R. E. "Using Influence Diagrams for Built-in-test," talk given
at the ATAC Workshop Navair Meeting organized by Jim Smith of the
Naval Air Systems Center in Mountain View, CA., Wednesday, October
30, 1985.

Barlow, R. E. "Influence Diagrams." Operations Research Center
Technical Report ORC 86-21, November 1986. To be published in the
<u>Encyclopedia of Statistical Sciences,</u> S. Kotz and N. L. Johnson,
editors.

RESEARCH SUMMARY

This research contract was motivated by the Naval Air System Center's
desire to obtain efficient computational methods for evaulating the
reliability of avionics sytems with built-in-test (BIT). The methodology in
use in 1985 was based on Markov modelling. Unfortunately this methodology
involves an unacceptably large number of states and the attendant computations
require exponential running time in the number of states. Network reliability
research at Berkeley had shown that efficient algorithms are available for
special classes of network problems. Under this contract, Lucia P. Resende
developed a computer program called <u>Polychain</u> for the reliability of
undirected networks as part of her Ph.D. thesis research. This program was
made available to Dr. Randall Fleming of Systems Control Technology, Inc.,

Palo Alto, CA (a Navy contractor) and has been submitted to the <u>IEEE Transactions on Reliability</u> for publication.

Also in conjunction with this contract, an <u>Advanced Study Institute on System Reliability and Computational Complexity</u> was held at Berkeley from June 24-July 3, 1985. The featured speaker was Professor A. Satyanarayana from the Stevens Institute of Technology in New Jersey. I also gave a lecture on "Computational Complexity of Coherent Systems and the Reliability Polynomial." The purpose of this lecture was to tie network reliability research with that of fault tree research. BIT reliability can also be computed using fault tree diagrams. This was pointed out at an ONR sponsored workshop in Palo Alto October 30, 1985.

Fault trees are special cases of so-called <u>influence diagrams</u>. Since this was a related, emerging research field, considerable research was done on influence diagrams. An Encyclopedia article by myself on influence diagrams made the subject more accessible to statisticians. Work with Ross Shachter on influence diagram operations applied to fault trees resulted in the paper on "Efficient Inference on Generalized Fault Diagrams."

STUDENTS AND FACULTY SUPPORTED BY THIS CONTRACT

Richard E. Barlow, P. I.

Srinivas Iyer. Ph.D. May 1, 1986. Thesis: Domination Theory, Network
Reliability and the Factoring Algorithm.

Lucia Resende. Ph.D. student in progress. Project: Extensions to
Polychain: Nonseparability Testing and the Factoring Algorithm.

Professor A. Satyanarayana. Computer Science Department, Stevens
Institute of Technology. Travel expenses for lectures in the
Advanced Study Institute on System Reliability and Computational
Complexity.

Professor Ross Shachter, Department of Engineering Economic Systems,
Stanford University. (I worked with Professor Shachter during the summer
of 1985 on influence diagram applications to fault trees.)

END

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